REMARKS

Applicants thank Examiner Paik for indicating that Claims 8, 9, and 29 are allowed.

Amended Claim 29 is allowed. Claims 30-48 depend on allowed Claim 29. Thus, Claims 29-48 are in a condition for allowance.

As previously noted, the claimed invention is directed at solving a problem of uniformly heating a semiconductor substrate by means of a hot plate. The general design of a hot plate is known. At least one resistive element is coupled to an insulating substrate; wherein the heat emanated from the resistive element is transmitted through the insulating substrate to the semiconductor substrate. A problem that occurs is that the semiconductor substrate is not heated uniformly. This can be problematic when the semiconductor substrate is coated with, for example, a precursor photosensitive material, in which the heating is necessary to develop said material. If the rate of material development is proportional to the developing temperature and if the developing temperature is non-uniform, then non-uniform heating may result in a non-uniformly developed material. This, in turn, may cause problems either in production or in performance of the final product. Accordingly, it is desirable to be able to transmit heat uniformly through the insulating substrate.

The inventors have studied this problem and have disclosed in the present application a solution, which reduces non-uniform transmission of heat from the resistive element through the insulating substrate to the semiconductor substrate. The inventors have observed that acceptable uniform heating of a semiconductor substrate occurs when the observed thickness dispersion of the resistive element is ± 3 μm. It is believed that uniform temperature transmission is made possible, in part or in whole, by forming a resistive element on a surface of an insulating substrate, in which the surface of the insulating substrate has a surface roughness of 2 μm or less. This fundamental discovery is believed to serve as a cornerstone for novelty and unobviousness over the disclosures of the cited references.

The rejection of Claims 1-5, 17-22, and 28 under 35 U.S.C. § 103(a) over Kubota et al. (U.S. 5,643,483) in view of Thimm et al. (U.S. 5,560,851), Hurko (U.S. 3,883,719) or Matsumura et al. (U.S. 5,151,871) is respectfully traversed.

The Examiner is correct that Kubota et al. teach surface roughness Rmax of the substrate plate that ranges from 2 μm to 200 μm (col. 3, ℓℓ. 50-52). However, Kubota et al. does not describe or suggest that the thickness dispersion of the heater element.

It is true that Matsumura et al. describes a conductive thin film **14** having a thickness that ranges from 0.1 to 100 μm. However, there is no suggestion provided in any one of Thimm et al., Hurko, and Matsumura et al. in which a hot plate comprising a ceramic substrate has a surface roughness of 2 μm or less on a face that contacts a resistance element pattern having a thickness dispersion of ±3 μm. In the absence of this suggestion, it is believed that Claim 1 is unobvious over any combination of Kubota et al., Thimm et al., Hurko , and Matsumura et al.

It is kindly requested that the Examiner acknowledge the same and withdraw this rejection.

The rejection of Claim 7 under 35 U.S.C. § 103(a) over Kubota et al. in view of Thimm et al., Hurko, or Matsumura et al., and further in view of Fennimore et al. (U.S. 3,576,722) or DiGiacomo et al. (U.S. 5,442,239) is respectfully traversed.

The Examiner admits that Kubota, Thimm et al., Hurko, and Matsumura et al. does not disclose or suggest a resistance element having a multilayer structure. The Examiner thus relies on Fennimore or DiGiacomo.

Fennimore discloses a method for metalizing ceramics which relates to production of microcircuitry (col. 1, ℓℓ. 31-33). The method according to Fennimore includes the step of applying a refractory metal (titanium) to a ceramic (aluminum oxide) substrate, and further

includes the step of forming additional layers on the titanium layer (col. 1, ℓℓ. 43-51). The titanium film is applied by vacuum deposition accomplished through sputtering or by evaporation using an electron beam gun (col. 2, ℓℓ. 22-26).

However, Fennimore neither discloses nor suggests a hot plate for heating a wafer. It is highly unlikely that the metal layers function as a resistance element. Nor does Fennimore disclose or suggest anything about a thickness dispersion of the metal layers and its formation on the lower face of an insulating substrate having a surface roughness of 2 μm or less. Therefore, one cannot learn from Fennimore the effect of the present invention, that is, the temperature uniformity of the heating surface achieved by forming a resistance element having a thickness dispersion within ±3 μm on the lower face of an insulating substrate having a surface roughness of 2 μm or less. Without the present disclosure as a guide, there would have been no motivation to combine Kubota, Thimm et al., Hurko, nor Matsumura et al.

DiGiacomo is drawn to a semiconductor component, e.g., a chip (col. 4, ℓℓ. 32-35), not a hot plate, and neither discloses nor suggests that the metal film can be used as a resistance element. DiGiacomo discloses that the metal layers can be formed by sputtering (col. 4, ℓℓ. 47-50), but is silent about the surface of an insulating substrate having a surface roughness of 2 μm or less and that contacts the metal layers having a small thickness dispersion on the surface opposite to the insulating substrate. DiGiacomo relates to structure and method for corrosion- and stress-resistance interconnecting metallurgy. Fig. 1 shows a metal film structure deposited on a substrate. The film comprises a layer of chromium, a layer of nickel, and a layer of noble metal (col. 4, ℓℓ. 46-57).

However, DiGiacomo discloses and suggests nothing about a hot plate, or that a metal film can be used as a resistance element. Further, DiGiacomo is silent about the surface roughness of the insulating substrate and its role in the thickness dispersion of the metal

layers. Therefore, one cannot glean from DiGiacomo the effect of the present invention, that is, the temperature uniformity of the heating surface achieved by forming a resistance element having a thickness dispersion within ±3 μm on the surface of an insulating substrate having a surface roughness of 2 μm or less.

As discussed above, Kubota, Thimm et al., Hurko, and Matsumura et al do not disclose or suggest anything about the surface roughness of the insulating support. Neither Fennimore nor DiGiacomo remedies the deficiency of these references. Indeed, neither Fennimore nor DiGiacomo disclose or suggest anything about a hot plate for heating a wafer, or the effect of the present invention, whereby temperature uniformity of the heating surface is achieved by forming a resistance element having a thickness dispersion within ±3 μm on the lower face of an insulating substrate having a surface roughness of 2 μm or less. Moreover, it is not clear why one skilled in the art would combine Kubota, Thimm et al., Hurko, nor Matsumura et al, with either Fennimore or DiGiacomo, but even if combined, the result would still not be the presently-claimed invention.

For all the above reasons, it is respectfully requested that the Examiner withdraw this rejection.

The rejection of Claims 23-27 under 35 U.S.C. § 103(a) over Kubota et al. in view of Thimm et al., Hurko, or Matsumura et al., and further in view of Morita et al. (U.S. 5,118,983) or Tsuruta et al. (U.S. 5,554,839) is respectfully traversed.

As noted above, any combination of Kubota et al., Thimm et al., Hurko, and Matsumura et al. does not suggest the hot plate of Claim 1. The same is true for Claim 23. Furthermore, Applicants take the position that neither Morita et al. nor Tsuruta et al. rectify this deficiency.

Morita describes a thermion electron source that has a resistive element **(2)** that contacts a metal-oxide substrate **(1)** **(2:1**; Figs. 1-3) or contacts a non-oxide protective film (8) which contacts the metal-oxide substrate (2:8:1; Fig. 4). An aspect that was discussed with the Examiner on October 13, 2004, is that Morita contains an express teaching away from the "roughness aspect" as presently claimed. For example, the Examiner's attention is directed to the text on col. 2, ℓℓ. 5-65. In particular, the aspect most pertinent to this discussion begins on col. 10, ℓ. 20. Morita describes that a non-oxide protective film (NOPF, **8**, see Fig. 4) comes in contact with the metal-oxide substrate and serves as a support for the resistive element; wherein both the NOPF and the metal-oxide substrate constitute the insulating substrate. A NOPF having a thickness of "several μm -100 μm" (col. 10, ℓ. 63ff) and made from AlN or BN may be used (col. 10, ℓ. 22). However, the most important feature of this entire passage is that the NOPF "is readily available in a monocrystalline state and...can be mirror finished by grinding on the surface *opposite the thin film resistive film*" (i.e., resistive element, col. 10, ℓℓ. 29-30, emphasis added herein). It is known that the NOPF is mirror finished by grinding on the side that contacts the metal-oxide substrate. Thus, grinding on the face of the NOPF opposite that of the resistive element will result in a reduction of the surface roughness of the face opposite that of the resistive element. Though not explicitly stated, it can be concluded that a reduction of the surface roughness on the NOPF face opposite to the resistive element is an important feature for this particular embodiment. Conversely, it can also be inferred that when Morita is silent with respect to grinding the NOPF on the face that contacts the resistive element; then it can be taken as an implicit suggestion that grinding the NOPF on the side that contacts the resistive element is unimportant for this particular embodiment.

This should be contrasted with the claimed invention in which it is important to have a surface roughness of 2 μm or less on the face of the insulating substrate in which the

precursor form of the resistive element is formed. The importance of this feature can be better appreciated by inspecting the observed thickness dispersion, surface roughness and temperature dispersion that occurs as described for the prepared samples (S1 – S5), as presented in the following Table (pages 13-15).

Sample №	Thickness Dispersion µm	Surface Roughness µm	Temperature Dispersion °C
S1	+0.7	0.5	0.2
S2	+0.5	0.1	0.15
S3	-0.3	0.03	0.1
S4	+2.0	0.5	0.25
S5	+3.1	2.1	0.4

It should be clear from the data shown in the Table that as the surface roughness increases, so too does the observed temperature dispersion. A reduction of surface roughness of the face of the insulating substrate that contacts the resistive element may be achieved by polishing (page 13, lines 17ff); wherein the extent of surface roughness can be approximately controlled (page 14, lines 1-5).

Referring back to the discussion of Morita, it should be clear that Morita description suggests that grinding on the face of the NOPF which is opposite to the resistive element is important, but that grinding on the face of the NOPF that contacts the resistive element is unimportant. Seeing that this suggestion is in direct contrast to the claimed invention, the Examiner is requested to recognize that the claimed invention is unobvious in view of the references. Especially in view of this direct "teaching away."

Tsuruta contributes to the cumulative information of the cited references, but does not provide the missing link needed to sustain a prima facie case of obviousness. While Tsuruta is directed to aspects of a heating body embedded in a ceramic substrate in the application of an oxygen sensor, Tsuruta does not describe or suggest forming a resistive element on the

surface of an insulating substrate whose surface roughness is 2μm or less. Tsuruta provides pictorial evidence for the roughness of a surface that does not make contact with a resistive element, which is depicted in the electron microscope photographs (Figs. 7-9) of an embodiment (Ex. 4) of the invention. While it is impossible to determine with precision the actual surface roughness of the ceramic substrate that contacts the heating body (resistive element), due to the image quality, it is possible to estimate the surface roughness of the ceramic substrate opposite to the heating body (top portion of Fig. 7). Using the scale provided and a straight-edge one can approximate the peak-to-valley distance to be about 4.2 μm, which yields a root-mean-square-value of about 3 μm. But most importantly, the disclosure of Tsuruta never suggests that uniform heating of a sample may be controlled by reducing the surface roughness of the face of the ceramic, which contacts the resistive element, to a value of 2 μm or less. Instead, Tsuruta describes enclosing resistive elements within the body of a ceramic substrate, in which an entire face of the resistive element does not contact the surrounding ceramic substrate (See Fig. 3B); with the aim of reducing cation migration and not reducing temperature non-uniformity.

Thus, as discussed above, Kubota et al., Thimm et al., Hurko, and Matsumura et al. Morita, and Tsuruta do not disclose or suggest anything about scaly noble metal powder, a surface roughness of 2 μm or less, or a thickness dispersion of the resistance element.

For all the above reasons, it is respectfully requested that these rejections be withdrawn.

Applicants respectfully submit that all of the presently-pending and active claims in this application are now in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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